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ABSTRACT

School mathematics is governed by a powerful tradition as regards both content and methods. In the first stage of the Alternative Course of Mathematics (ALM) project, an analysis is being made of the mathematics used in the everyday life of the community. By interviewing adults and children outside school, an analysis is also being made of the way in which people handle this mathematics, which methods they employ and how, for example, they use modern aids such as the pocket calculator. Both analyses can be related to the concept of "Ethnomathematics" in the broad sense. The main concern of the ALM project is to inquire whether any of this mathematics can be introduced as an alternative in school mathematics and whether any of the methods which people use in their everyday lives or in their working lives can also be presented as a method in school mathematics. Under the ALM project, therefore, parallel to research activities, an experimental scheme is being conducted in various grades to test new methods. (Author/YP)

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SCHOOL RESEARCH NEWSLETTER

Current project

TITLE OF PROJECT: ALTERNATIVE COURSE OF MATHEMATICS
The ALM project

School mathematics is governed by a powerful tradition as regards both content and methods. The aim of teaching is to equip the pupils with general mathematical methods for solving problems of different kinds. Teaching also reflects the hierarchic structure of mathematics. In the first stage of the ALM project, an analysis is being made of the mathematics used in everyday life of the community. By interviewing adults and children outside school, an analysis is also being made of the way in which people handle this mathematics, which methods they employ and how, for example, they use modern aids such as the pocket calculator. Both analyses can be related to the concept of "Ethnomathematics" in the broad sense.

The "ethnomathematics" concept was launched by DÁmbrosio (1985) The main concern of the ALM project is to enquire whether any of this mathematics can be introduced as an alternative in school mathematics and whether any of the methods which people use in their everyday or in working lives can also be presented as a method in school mathematics. Although the aim of school mathematics is firmly established, the method method for achieving that aim could be to use findings from ethnomathematical research.Under the ALM project, therefore, parallel to research activities , an experimental scheme is being conducted in various grades (mostly grades 1 for the 1988/89 school-year) to test new methods. Experiments in several other grades are planned from 1989/90 onwards.

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Background

What mathematics is used in the community? How do people manipulate this mathematics in everyday situations?

By confronting people (both adults and pupils at different levels of school) with everyday situations and studying how they cope with them, one can acquire a deeper knowledge of the link between everyday situations and the content of mathematics.

By studying the way in which people cope with problems/situations, one can obtain a point of departure for indicating, in the teaching context, applications of mathematics to everyday living.

A study of this kind represents an attempt to provide what Marton (1986) terms an explanation from the inside, i.e. one identifies the "insights and specific skills" lacking in persons who do not deal with the situation/problem in a qualitatively rational manner.

The studies are based on interviews concerning mathematical problems, a method employed in many studies, e.g. Unenge (1982).

Analysis of the findings can give the answers to the following questions:

- Are there differences between the content of school mathematics and the mathematics actually used in everyday life?
- Are there methods in people's way of using mathematics which can be introduced in school and presented as a methodological variant?

Changes proposed

On the basis of increasingly comprehensive didactic research, many changes have been suggested to the content and methods of school mathematics.

Pocket calculators and computers

The increasing availability of pocket calculators, which today are an essential aid in working life and everyday living, naturally represents,

in its own right, a revolution in elementary mathematics. Computers are playing a similar role further up in the grades.

The pocket calculator reduces the need for "pencil-and-paper arithmetic", and it is the obvious aid for difficult calculations running into several digits. Cockroft (1982) takes the view that the pocket calculator should be used from the very first grade, but this does not mean relinquishing insistence on the pupils "knowing their tables", for example. However, the pocket calculator makes it possible, from an early stage, to work with real-life quantities.

Informal mathematics

The introduction of the pocket calculator means less demand for a knowledge of algorithms; alternatively, it means the complete elimination of algorithms. Instead pupils are called upon to make informal notes when they are unable to work out the sums in their heads. Many experimental findings suggest that work using informal algorithms of this kind leads to greater understanding and that, in other connections as well, the pupils begin to use efficient but informal notes.

Estimation

Estimation can be divided into three parts:

- Capacity for reading off and judging the magnitude of numbers and quantities.
- Capacity for efficiently simplifying and converting arithmetical calculations, e.g. putting 6 x 9 instead of 12 x 4.5.
- Capacity for estimating magnitudes, e.g. the number of oranges per kg.

Ethnomathematics

The term "ethnomathematics" was launched by the Brazilian researcher D'Ambrosio (1985). The school mathematics we employ is based entirely on a (limited) question culture and takes as its starting point a traditional, "academic" mathematics.

> "In contrast to this we will call ethnomathematics the mathematics which is practised among identifiable cultural groups, such as national-tribal societies, labor groups, children of a certain age bracket, professional classes, and so on. Its identity depends largely on focuses of interest, on motivation, and on certain codes and jargons which do not belong to the realm of academic mathematics. We may go even further in this concept of ethnomathematics to include much of the mathematics which is currently practised by engineers, mainly calculus, which does not respond to the concept of rigor and formalism developed in academic courses of calculus." (p. 45)

This idea of the traditional structure and content of school mathematics as a potential obstacle to learning where many pupils are concerned is corroborated by several studies. One study also emanating from Brazil (Carraher, Carraher & Schliemann, 1985) shows, for example, how youngsters attending school who eke out the family finances by working as "street vendors" perform all the necessary calculations in their heads without a hitch. And yet, given the same tasks in school, they run into great difficulty.

Situation mathematics

The term "situation mathematics" has been launched within the ALM project.

A mathematical task can be rated on a scale according to its degree of "openness" from "exercises" to "situations".

One example of an "exercise" is the task of working out 5 x 46 - the mode of calculation is given. The task of "planning a holiday journey", on the other hand, belongs to "situations" - one has to decide one's own conditions, formulate one's own questions and decide which of them can be answered mathematically.

Lgr 80 (the Swedish Compulsory School Curriculum) says that the aim of school instruction is for the pupils, primarily, to acquire a mastery of important, frequently occurring "situations". That end can be achieved by

various methodological means. The means we employ proceeds through the traditional school subjects.

Mathematics here contributes mathematical models and skills regardless of situation and of other school subjects. The latter provide other aspects of knowledge and the pupils are then expected to realise and integrate all these different things by themselves when faced with the situation outside school or after leaving school.

The role of mathematics in compulsory school can be viewed in another perspective. Referring again to Lgr 80, one important raison d'être of mathematics is that of preparing the pupils so that they will be able to deal rationally with everyday situations - a concern which, of course, is not confined to mathematics. The knowledge desired would then be acquired by another path, one emanating from the situations.

The idea of starting with "the situation" instead of the subject can yield new approaches. "The situation" is often more complicated, non-trivial, than many of the text assignments which, traditionally, we work with in school mathematics. Certain "situations" demand a simple knowledge of mathematics but can demand a good "knowledge of the world", while others may involve a larger dose of mathematics. In a situation-based mathematics course, this whole point is immediately made clear.

A "situation" also includes many stages when it is to be tackled:

- Discovering and formulating the situation.
- Formulating the question one wants an answer to.
- Collecting all the data.
- Settling on a solution strategy.
- Performing any calculations.
- Judging the plausibility of the result.
- Deciding a course of action on the strength of the result.

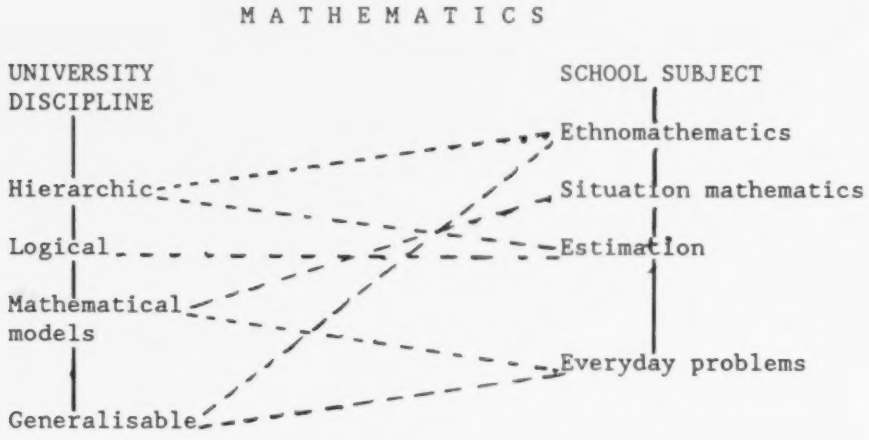
A list of this kind leads to criticism of "traditional" mathematics tasks and perhaps also to criticism of parts of the content and terminology of the mathematics course.

University mathematics - school mathematics

Mathematics in schools is rooted in the academic discipline of mathematics. Some criteria are that mathematics is hierarchic, it is logical, it employs models often described in formulae or rules, and it is amenable to generalisation.

The concept of "school mathematics" has been launched in recent years. This is viewed as a specific delimitation of academic mathematics which can be built up round other criteria.

A comparison between the university discipline and the school subject of mathematics can be based on the following figure:



There are of course links between these two vertical "main lines". The left-hand line refers to the laws, rules and truths of mathematics. Hitherto, the planning of school mathematics has been based on the left-hand line, and so the problem is to find applications in (parts of) the right-hand one. "Everyday problems", as they have often come to be designed, are a typical example of this.

Clearly, many pupils do not understand the hierarchic and logical structure of mathematics; they do not understand the refinement (and the limitations) of mathematical models and they are not capable of making (the permissible) generalisations. The dashed lines between the "main lines" lead to the following questions:

- Can a point of departure along the right line make the pupils see "the points"?
- Can "Estimation" be a good point of departure for showing, for example, how logically our system of measurement is constructed?
- Can Situation mathematics be a point of departure for motivating a certain acquisition of skills?
- Can pocket calculators (which are of course included in Ethnomathematics) confer liberty from the hierarchy while building up the right-hand line, so that the hierarchy can become a sensation of discovery in senior grades?
- Can Ethnomathematics provide examples of new methods of solving everyday problems (situations) and showing pupils how mathematics can be used in everyday life?

Some pilot experiments

A number of pilot studies and experiments were undertaken during the 1988/89 school year as part of the ALM project. Those studies can be divided into a research section and an experimental section.

Within the research section, studies are being made of the mathematics actually used in the community and in people's everyday lives. This investigation is taking the form of interviews and of systematic studies, for example, of daily newspapers and television and radio news broadcasts. The way in which people handle this mathematics is also being studied, by confronting experimental subjects during interviews with various situations involving mathematics.

In the research section, a grade 1-3 class has worked without algorithms in a minor experiment. The pupils employed informal notes and for work relating to everyday situations they were allowed to use pocket calculators.

This experiment forms the basis of a larger experiment beginning in four grade 1 classes during the 1988/89 school year. The aim of the experiment has been broadened to comprise:

Teaching designed to give the pupils numbers and mathematics instead of figures, symbols and rules.

This approach can be illustrated by means of an example. Compare the following presentations of a simple task:

(a) 147 + 28

(b)
$$\begin{array}{r} 147 \\ +\ 28 \\ \hline \end{array}$$

In alternative (a) there are two numbers to be added, and this can be done in many different ways. One can say "+3 makes 150" and so on, or one can "round off 28 to 30" and so on, or again one can start with 150 + 30 and then adjust the result. This latter alternative provides an example of the exciting method of teaching the pupils to calculate approximately to begin with and more exactly afterwards (if the situation requires), i.e. to do what adults often do in everyday life.

In alternative (b) there is one and only one way of doing the sum; at all events, the problem is presented in these terms in algorithmic teaching. But then the numbers disappear and one is left manipulating figures, starting with 7 + 8 and "carry 10" (a figure, not a number!) and so on. And once the numbers have disappeared, the answer can be just anything; 1,615 is no uncommon answer to the sum as stated in alternative (b).

The pupils have spent the autumn term analysing numbers (up to 10) by various kinds of subdivision. This experiment is a continuation of Dagmar Neuman's research findings (1987).

Starting in the 1989 school year, more comprehensive experiments are planned, beginning with grades 1, 4 and 7. In the more senior grades, efforts will then be made to introduce results from the analyses of the ethnomathematical studies, as regards both course content and methods.

An initial report on the project will be presented during the spring of 1989.

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